

IN THE CLAIMS:

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1. (Original) A method for recovering phase information comprising:
over-sampling data transmitted at a first frequency using a clock at a second frequency to obtain groups of n samples;
storing a plurality of m of said groups of n samples;
outputting said plurality of m of said groups of n samples simultaneously at a clock frequency which is said second frequency divided by m .
2. (Original) A method according to claim 1 and further including:
using said plurality of m of said groups of n samples to detect transitions in said data; and
maintaining an historical record of said transitions.
3. (Original) A method according to claim 2 and further including:
using said historical record to determine a phase of said second frequency that is nearly centered in the middle of a bit time of said data at said first frequency.
4. (Original) A method according to claim 3 wherein said step of determining a phase comprises:
 - a. Oring each history bit with the following bit to obtain a highest byte;
 - b. Oring each bit in said highest byte with a bit on either side to obtain a second highest byte;
 - c. Oring each bit in said second highest byte with a bit on either side to obtain a third highest byte; and
 - d. determining the highest level byte which has two or fewer zeros and outputting:
 - i. the phase of the sole remaining zero if there is only one zero;
 - ii. the phase of the latest zero if an adjacent pair remains;
 - iii. an error indication if two non-adjacent zeros remain.

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5. (Original) A method according to claim 4 and further including limiting the maximum phase change to plus or minus one sample phase.

6. (Original) A method according to claim 3 and further including:
using said historical record to select bits of said data at said first frequency and output said bits in groups of generally m valid bits at a time at said second frequency divided by m .

7. (Original) A method according to claim 6 wherein, due to the difference in said first and second frequency a drift occurs causing said phase to select $m+1$ or $m-1$ bits of data and further including:

outputting either m , $m+1$ or $m-1$ valid bits; and

using said historical record to provide an indication of how many bits are being output.

8. (Original) A method according to claim 7 wherein said step of providing an indication of how many valid bits are being output comprises:

- a. determining whether the current phase selection is different from the previous phase selection and if not, indicating that bits $m:1$ are valid;
- b. if the current phase selection is different from the previous phase selection, determining if the current phase selection wraps around from the previous phase selection and if not, indicating that bits $m:1$ are valid;
- c. if the current phase selection wraps around from the previous phase selection determining if it wraps around from the latest to earliest sample phase, and, if so, indicating that bits $(m-1):1$ are valid; and
- d. if the current phase selection wraps around from the previous phase selection determining if it wraps around from the earliest to latest sample phase, and, if so, indicating that bits $m:0$ are valid.

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9. (Currently Amended) A method for recovering phase information comprising:
over-sampling data transmitted at a first frequency using a clock at a second frequency, n times per bit time to obtain n samples;
using said n samples to detect the transitions between two logic levels in said transmitted data $[[an]]$ and provide n edge results which are at one logic level to indicate a transition and the other logic level to indicate no transition;
storing, in sequence, at said second clock frequency, m sets of said n samples; and
outputting said m times n samples at a clock frequency which is said second frequency divided by m .

10. (Original) A method according to claim 9 and further including maintaining a running history of said edge results comprising:
combining in n separate m input OR gates the m times n samples, each gate having as inputs the m of said samples in the same relative position in each of said m sets;
using the outputs of said n OR gates to set p sets of byte registers, each having n registers; and
resetting said p byte registers in a wrap around sequence.

11. (Original) A method according to claim 10 and further including:
using outputs of said byte registers to determine a phase of said second frequency that is nearly centered in the middle of a bit time of said data at said first frequency.

12. (Original) A method according to claim 11 wherein said step of determining a phase comprises:

- a. Oring each history bit with the following bit to obtain a highest byte;
- b. Oring each bit in said highest byte with a bit on either side to obtain a second highest byte;
- c. Oring each bit in said second highest byte with a bit on either side to obtain a third highest byte; and

- d. determining the highest level byte which has two or fewer zeros and outputting:
 - i. the phase of the sole remaining zero if there is only one zero;
 - ii. the phase of the latest zero if an adjacent pair remains;
 - iii. an error indication if two non-adjacent zeros remain.

13. (Original) A method according to claim 12 and further including limiting the maximum phase change to plus or minus one sample phase.

14. (Original) A method according to claim 13 and further including:
using said phase to select bits of said data at said first frequency and output said bits in groups of generally m at a time at said second frequency divided by m .

15. (Original) A method according to claim 14 wherein, due to the difference in said first and second frequency a drift occurs causing said phase to select $m+1$ or $m-1$ bits of data and further including:

outputting either m , $m+1$ or $m-1$ bits; and

using said phase information to provide an indication of how many bits are being output.

16. (Original) A method according to claim 15 wherein said step of providing an indication of how many bits are being output comprises:

- a. determining whether the current phase selection is different from the previous phase selection and if not, indicating that bits $m:1$ are valid;
- b. if the current phase selection is different from the previous phase selection, determining if the current phase selection wraps around from the previous phase selection and if not, indicating that bits $m:1$ are valid;
- c. if the current phase selection wraps around from the previous phase selection determining if it wraps around from the latest to earliest sample phase, and, if so, indicating that bits $m-1:1$ are valid; and

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- d. if the current phase selection wraps around from the previous phase selection determining if it wraps around from the earliest to latest sample phase, and, if so, indicating that bits $m:0$ are valid.

17. (Original) Apparatus for recovering phase information comprising:
an over-sampler having an input for data transmitted at a first frequency and n sampling clock inputs each at a second frequency but different phase each clock shifted in phase from an adjacent clock by $360/n$ degrees and providing n sample outputs; and
a sample word register having inputs coupled to said n sample outputs, storing m sets of said n sample outputs at said second frequency and outputting said m sets of n sample outputs at a frequency equal to said frequency divided by m .

18. (Original) Apparatus according to claim 18 and further including an edge detector using said m sets of n sample outputs to detect the transitions between two logic levels in said transmitted data and provide m sets of n edge results which are at one logic level to indicate a transition and another logic level to indicate no transition.

19. (Original) Apparatus according to claim 18 wherein said edge detectors comprise a plurality of XOR gates.

20. (Original) Apparatus according to claim 19 and further including:
 n separate m input OR gates, each gate having as inputs the m of said n edge results in the same relative position in each of said m sets of n edge results; and
 p sets of n -bit byte registers, the outputs of each of said n OR gates being a set input to one of the n bits in each of said p byte registers.

21. (Original) Apparatus according to claim 20 and further including a packet state machine providing reset inputs to said byte registers.

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22. (Original) Apparatus according to claim 21 and further including:
phase selection logic having the outputs of said byte registers as inputs and
outputting a signal indicating a phase of said second frequency that is nearly centered in
the middle of a bit time of said data at said first frequency.

23. (Original) Apparatus according to claim 22 and further including:
a data selector register having a data input from said sample register and the
output of said phase selection logic as a select input to select bits of said data at said first
frequency and output said bits in groups of generally m valid bits at a time at said second
frequency divided by m.

24. (Original) Apparatus according to claim 23 wherein due to the difference in said
first and second frequency a drift occurs causing said data selector register to output m+1
or m-1 valid bits of data and further including:

a bit count state machine providing as an output an indication of how many valid
bits are being output by said data selector register.

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